UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,845,175 B2
APPLICATION NO. : 09/830264
DATED : January 18, 2005
INVENTOR(S) : Avi Kopelman et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

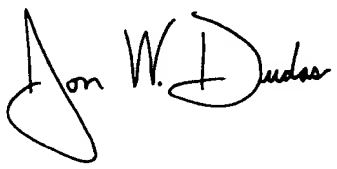
Delete the title page and substitute therefore the attached title page.

Delete Drawing Sheets 1-11 and substitute therefore the attached Drawing Sheets 1-9.

This certificate supersedes Certificate of Correction issued August 21, 2007.

Signed and Sealed this

Eighteenth Day of September, 2007



JON W. DUDAS
Director of the United States Patent and Trademark Office

(12) **United States Patent**
Kopelman et al.

(10) **Patent No.: US 6,845,175 B2**
(45) **Date of Patent: Jan. 18, 2005**

(54) **DENTAL IMAGE PROCESSING METHOD AND SYSTEM**

(75) Inventors: Avi Kopelman, Tel Aviv (IL); Eldad Taub, Reut (IL)

(73) Assignee: Cadent Ltd., Or Yehuda (IL)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 479 days.

(21) Appl. No.: 09/830,264

(22) Filed: Apr. 23, 2001

(65) **Prior Publication Data**

US 2003/0169913 A1 Sep. 11, 2003

Related U.S. Application Data

(63) Continuation of application No. PCT/IL99/00577, filed on Nov. 1, 1999.

(30) **Foreign Application Priority Data**

Nov. 1, 1998 (IL) 126838

(51) Int. Cl.[7] G06K 9/00
(52) U.S. Cl. 382/154; 382/294; 128/922
(58) Field of Search 382/128, 131, 382/154, 285, 294; 600/587, 589, 590; 128/922; 433/24, 29, 68, 69, 215

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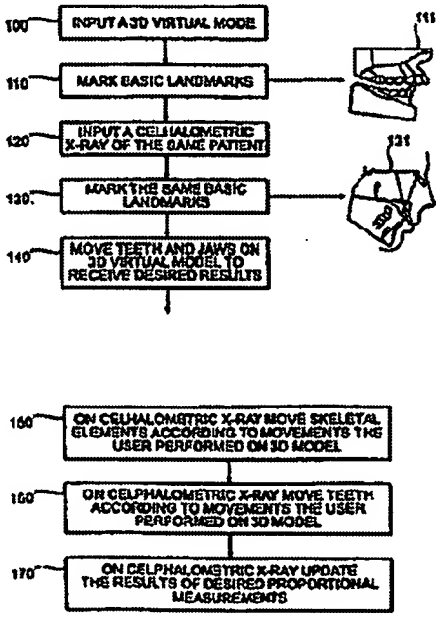
Primary Examiner—Todd E. Manahan
(74) *Attorney, Agent, or Firm*—Nath & Associates PLLC; Gary M. Nath; Lee C. Heiman

(57) **ABSTRACT**

An image processing method for use in dentistry or orthodontic is provided. Two images of teeth, one being a two-dimensional image and one a three-dimensional image are combined in a manner to allow the use of information obtained from one to the other. In order to combine the two images a set of basic landmarks is defined in one, identified in the other and then the two images are registered.

23 Claims, 9 Drawing Sheets



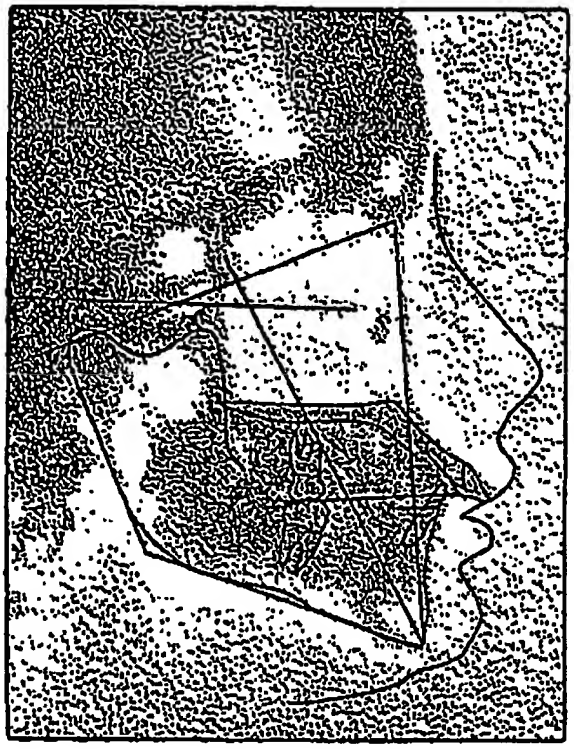


FIG. 1A

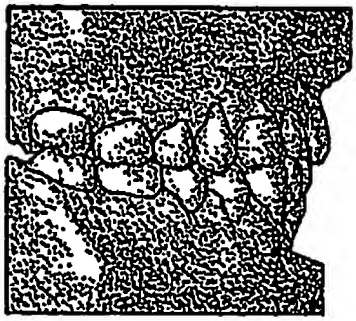


FIG. 1B
PRIOR ART

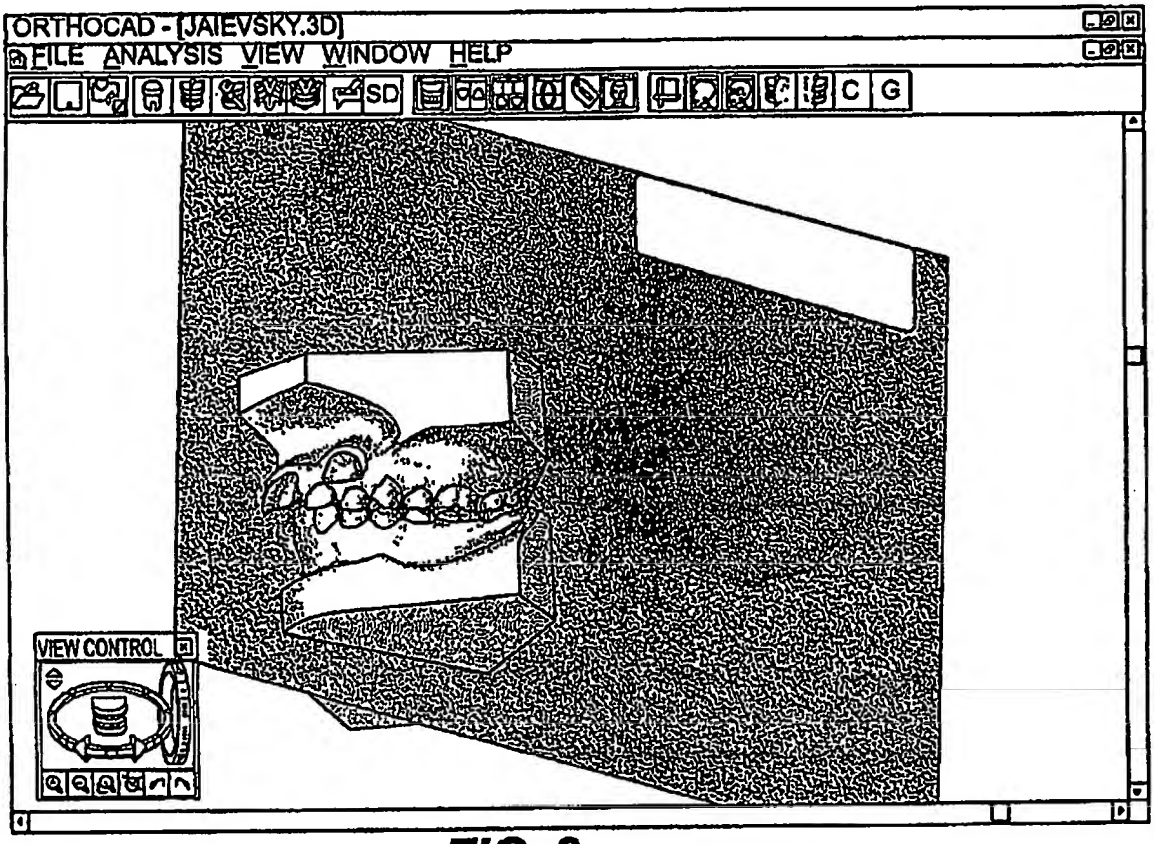

ORTHOCAD - [JAIEVSKY.3D]
FILE ANALYSIS VIEW WINDOW HELP
SD
C
G
VIEW CONTROL

FIG. 2

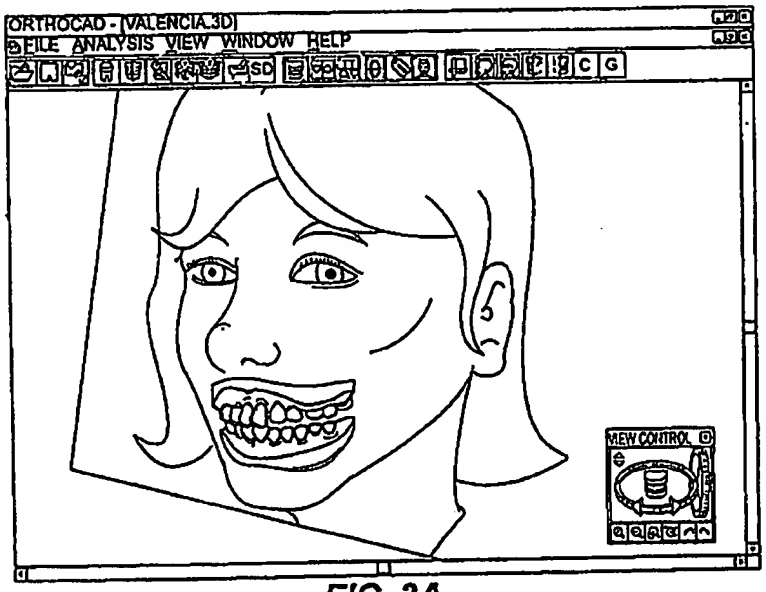
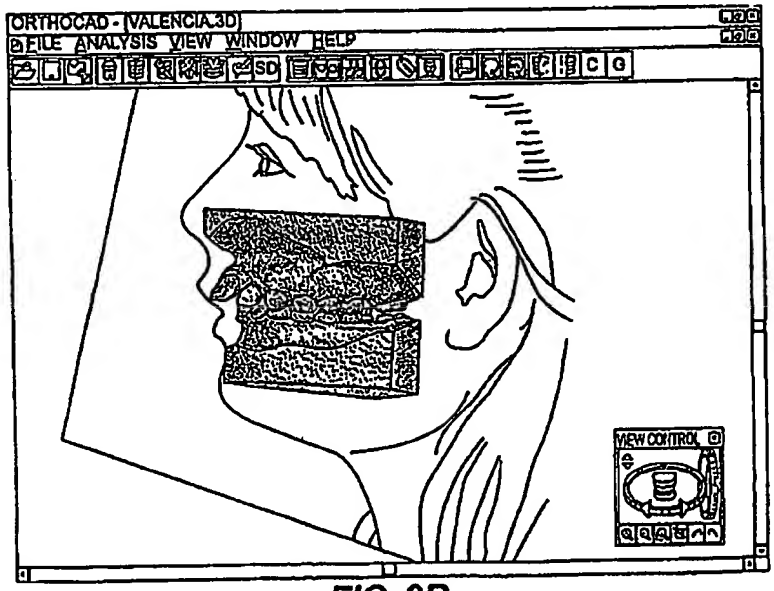

ORTHOCAD - [VALENCIA.3D]
FILE ANALYSIS VIEW WINDOW HELP
VIEW CONTROL

FIG. 3A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FILE ANALYSIS VIEW WINDOW HELP
VIEW CONTROL

FIG. 3B

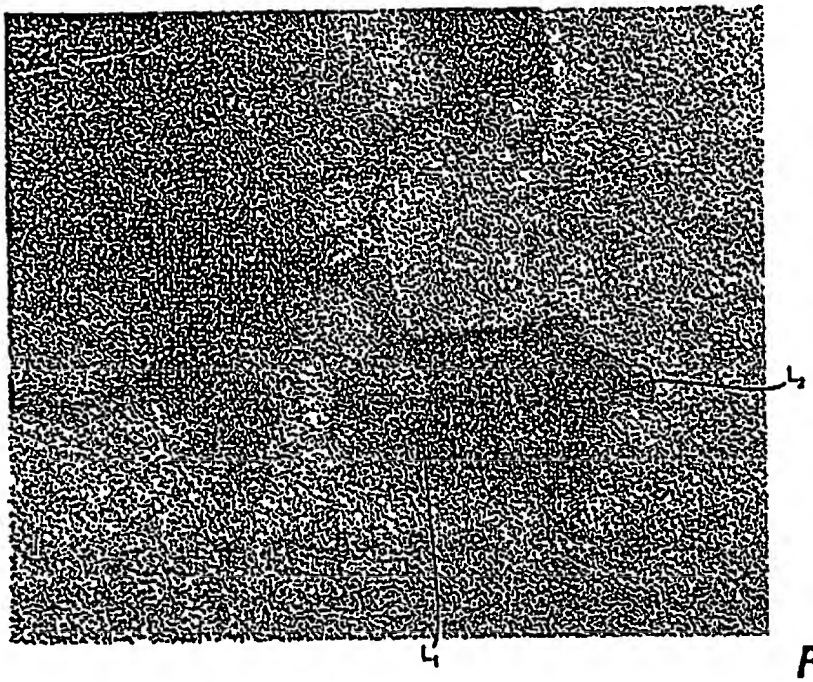

FIG. 4A

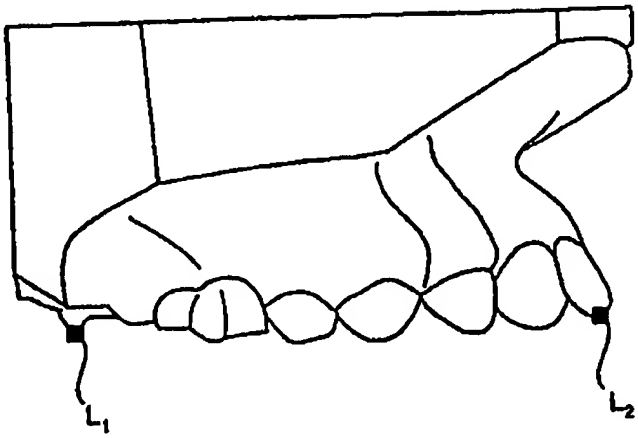

FIG. 4B

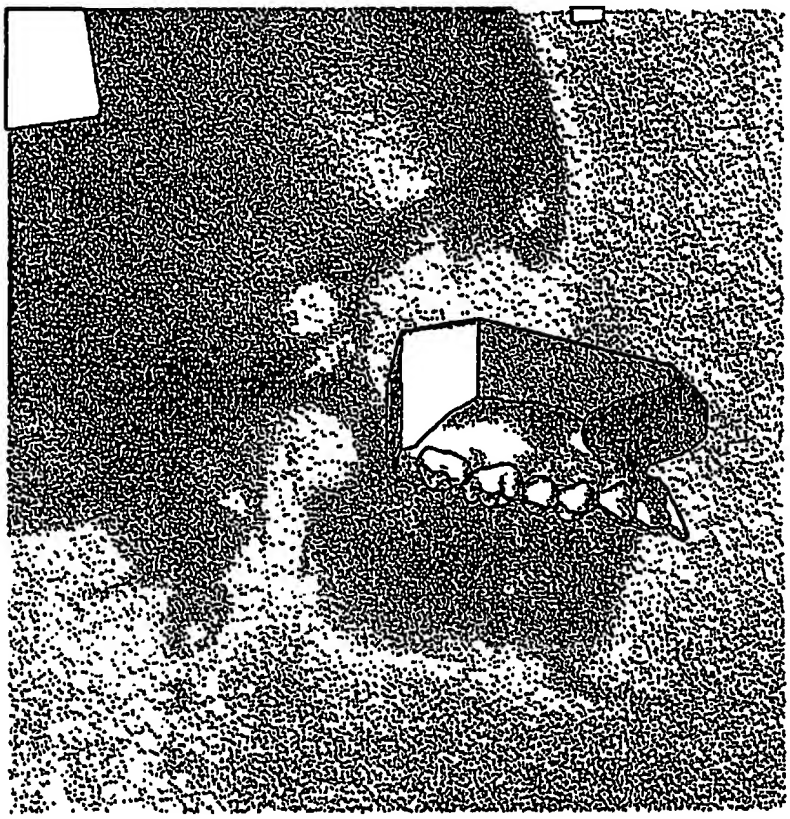

FIG. 5

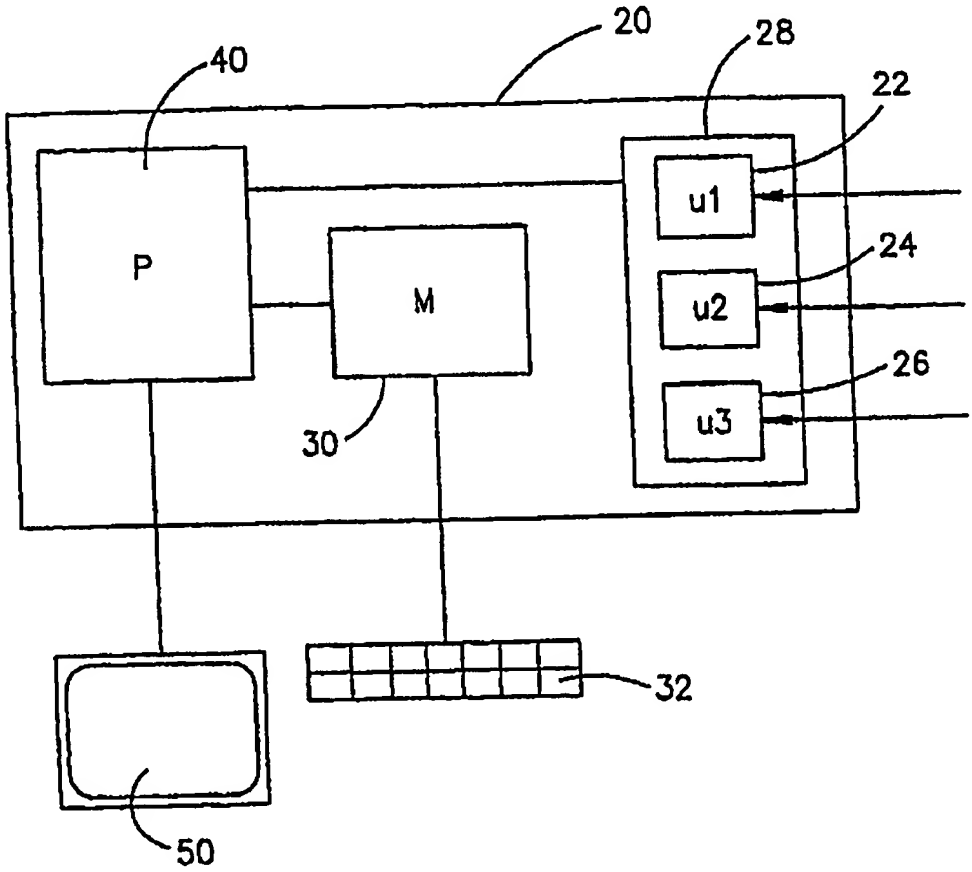

FIG.6

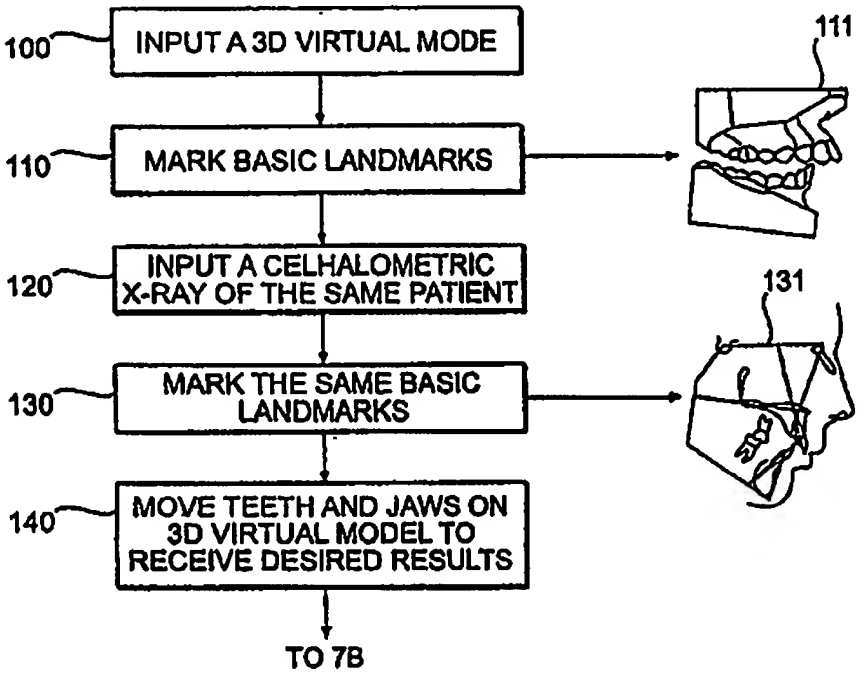
100
INPUT A 3D VIRTUAL MODE
110
MARK BASIC LANDMARKS
120
INPUT A CELHALOMETRIC X-RAY OF THE SAME PATIENT
130
MARK THE SAME BASIC LANDMARKS
140
MOVE TEETH AND JAWS ON 3D VIRTUAL MODEL TO RECEIVE DESIRED RESULTS
TO 7B
111
131

FIG. 7A

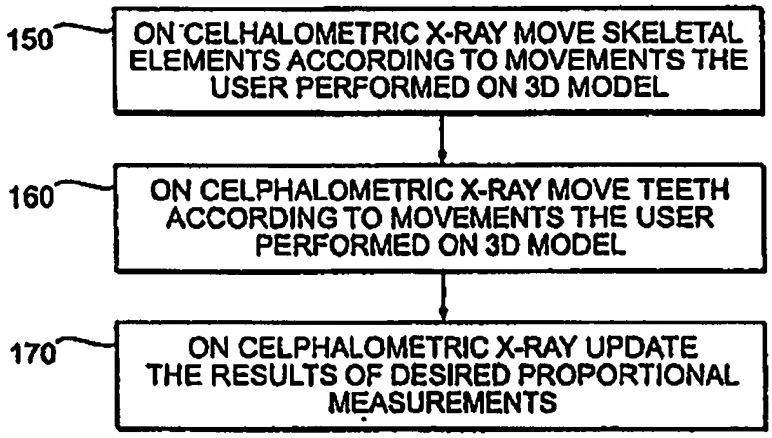
150
ON CELHALOMETRIC X-RAY MOVE SKELETAL ELEMENTS ACCORDING TO MOVEMENTS THE USER PERFORMED ON 3D MODEL
160
ON CELPHALOMETRIC X-RAY MOVE TEETH ACCORDING TO MOVEMENTS THE USER PERFORMED ON 3D MODEL
170
ON CELPHALOMETRIC X-RAY UPDATE THE RESULTS OF DESIRED PROPORTIONAL MEASUREMENTS

FIG. 7B

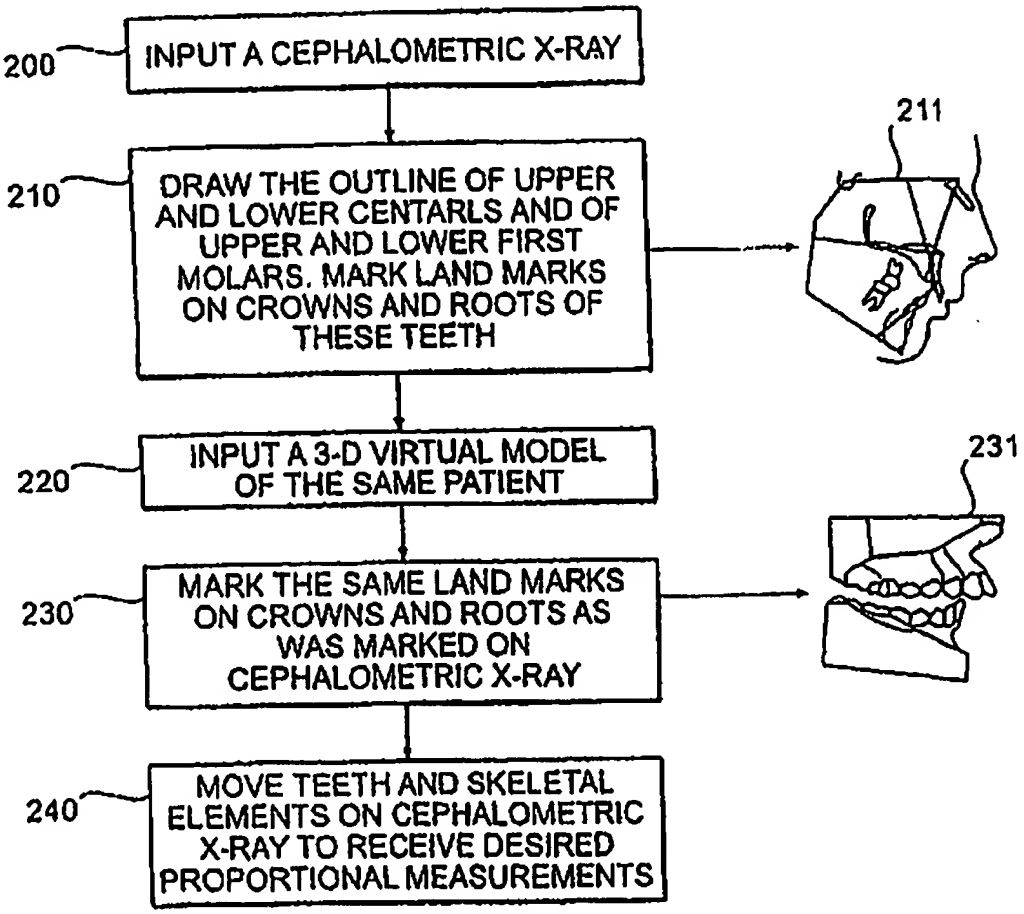
200
INPUT A CEPHALOMETRIC X-RAY
210
DRAW THE OUTLINE OF UPPER AND LOWER CENTARLS AND OF UPPER AND LOWER FIRST MOLARS. MARK LAND MARKS ON CROWNS AND ROOTS OF THESE TEETH
211
220
INPUT A 3-D VIRTUAL MODEL OF THE SAME PATIENT
231
230
MARK THE SAME LAND MARKS ON CROWNS AND ROOTS AS WAS MARKED ON CEPHALOMETRIC X-RAY
240
MOVE TEETH AND SKELETAL ELEMENTS ON CEPHALOMETRIC X-RAY TO RECEIVE DESIRED PROPORTIONAL MEASUREMENTS

FIG. 8A

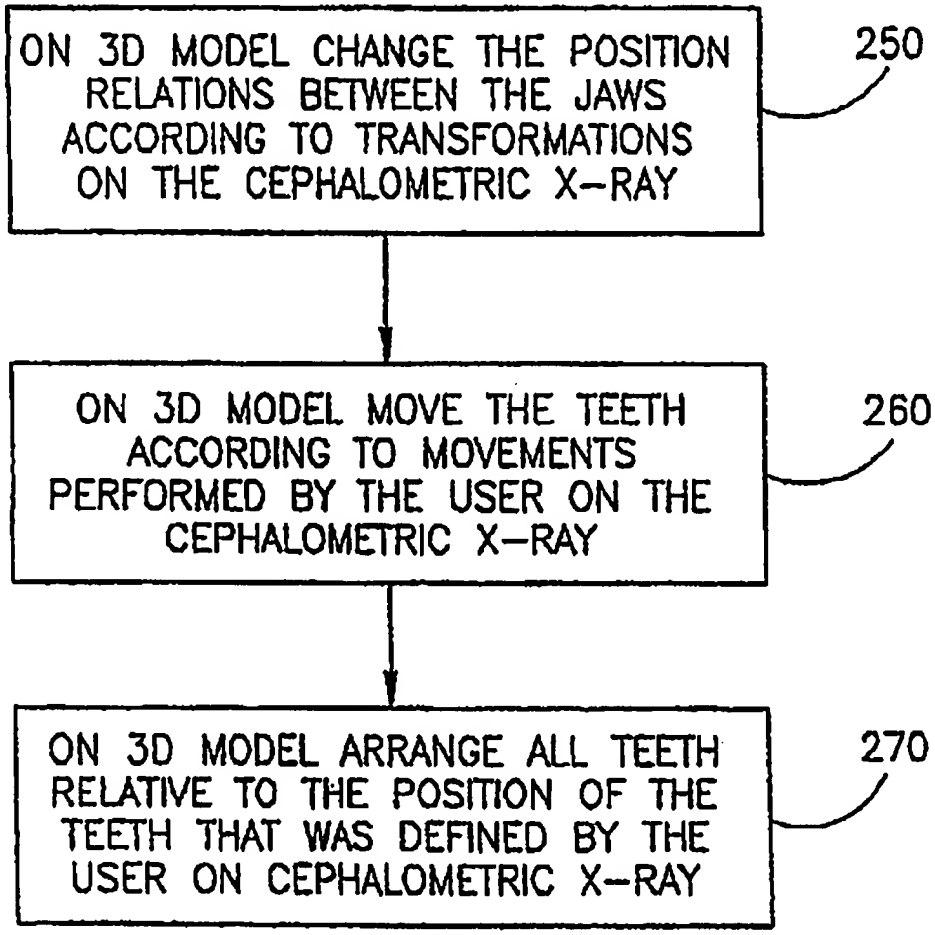
ON 3D MODEL CHANGE THE POSITION RELATIONS BETWEEN THE JAWS ACCORDING TO TRANSFORMATIONS ON THE CEPHALOMETRIC X-RAY
250
ON 3D MODEL MOVE THE TEETH ACCORDING TO MOVEMENTS PERFORMED BY THE USER ON THE CEPHALOMETRIC X-RAY
260
ON 3D MODEL ARRANGE ALL TEETH RELATIVE TO THE POSITION OF THE TEETH THAT WAS DEFINED BY THE USER ON CEPHALOMETRIC X-RAY
270

FIG.8B